Success Story

Advanced Diesel Technologies Help Manufacturers Meet 2007 Emissions Standards

Background

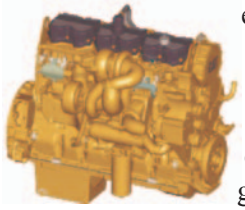
Heavy-duty, freight-hauling trucks provide an invaluable service for our society, yet their diesel engines put significant amounts of harmful emissions into our atmosphere. In December 2000, the Environmental Protection Agency (EPA) set emissions standards for truck model years 2007 and later. The much stricter "2007 standards" for heavy-duty highway diesel engines mandate significantly lower allowable emissions of particulate matter (PM), nitrogen oxides (NO_x), and nonmethane hydrocarbons (NMHC), while also reducing the amount of sulfur permitted in diesel fuel.

A cost-shared cooperative research agreement between Caterpillar Inc. and the U.S. Department of Energy's FreedomCAR and Vehicle Technologies Program has led to more advanced truck engine technologies that are helping heavy-duty diesel engines meet emission standards for model year 2007 and beyond – while maintaining or even improving on-road fuel economy.

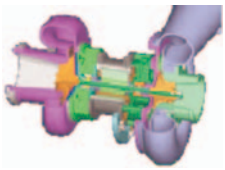
The Technology

The resulting new "clean diesel" technologies include improved combustion, exhaust aftertreatment, air-handling, and electronics and control systems.

Combustion. DOE has supported extensive research into diesel fuel spray formation and combustion bowl geometries, which aided Caterpillar in better understanding the diesel combustion process. This helped identify the need for high-pressure fuel injection systems that reduce engine-out particulate levels and minimize diesel particulate filter regeneration and replacement. The new fuel system was essential to lowering targeted engine-out emissions without reducing fuel economy.

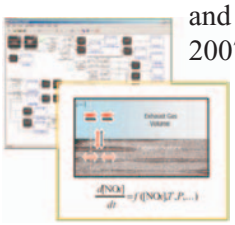


Air Handling. One research area involved a membrane-based technology DOE helped develop that removes some of the oxygen from the intake air to create a nitrogen-enriched air stream for combustion purposes. Higher concentrations of inert gases, such as nitrogen, help lower peak temperatures and slow the rate of combustion to reduce NO_x formation.



Aftertreatment. DOE helped fund research by Caterpillar that significantly reduced engine-out emission levels, including PM, which enabled the development of an advanced diesel particulate filter system. The new system offers improved thermal management and filter regeneration while maintaining fuel efficiency.

Electronics. DOE funded the design and development of a 2007-compliant demonstration truck that helped Caterpillar integrate all components, including the electronics and controls. The prototype vehicle improved Cat's understanding of how the technologies perform in real-world driving environments.



The Prototype

Caterpillar displayed its 2007 emissions-compliant truck on May 11, 2004 at a government/industry event in Washington, D.C. The on-highway truck, powered by a C-15 engine equipped with Cat's ACERT technology, featured real-time emissions monitoring technology. The Kenworth class 8 truck is equipped with diesel particulate filters, but does not require an additional reductant such as would be required with Selective Catalytic Reduction. It achieves 2007 emissions levels with essentially the same fuel economy as today and its fuel economy is expected to improve as final calibrations and refinements are made prior to production.

Benefits

- Significantly reduces emissions of diesel particulates, NO_x, and nonmethane hydrocarbons to meet EPA standards for model year 2007 and later heavy-duty, highway truck engines.
- Helps maintain or even improve on existing diesel engine fuel economy.

"The cost-shared cooperative research agreement with DOE gave Caterpillar access to additional funding and DOE's huge base of research, which enabled us to enhance our new ACERT technology to help meet 2007 emission levels and improve fuel economy. We were also able to accelerate our R&D timetable to better accommodate our production process."

David Milam
HTCD Program Manager
Engine Research Division

Contact

Jules Routbort
Argonne National Laboratory
(630) 252-5065
routbort@anl.gov

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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